(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 December 2003 (18.12.2003)

PCT

(10) International Publication Number
WO 03/103921 A1

(51) International Patent Classification[7]: B29C 44/18

(21) International Application Number: PCT/US03/16021

(22) International Filing Date: 20 May 2003 (20.05.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2002-169093 10 June 2002 (10.06.2002) JP

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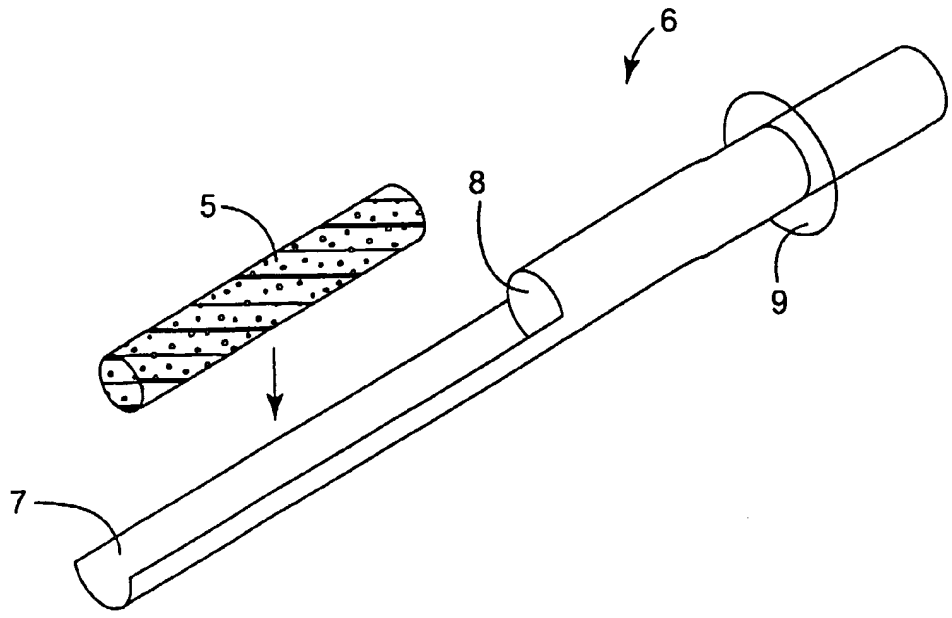
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: HOLLOW TYPE WEATHER STRIP, MANUFACTURING METHOD AND DEVICE



(57) Abstract: A weather strip (1) in an intermediate or final form that comprises a hollow portion (2) containing an expandable or expanded reinforcing filling member (5) formed of a solid thermo-foaming material having a pressure-sensitive adhesive on an exterior surface thereof, a method of manufacturing the weather strip and a loading device (6) for aiding in the manufacture of the weather strip. The hollow portion of the weather strip can be partially, mostly, or completely filled by the expandable reinforcing filling member.

WO 03/103921 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

HOLLOW TYPE WEATHER STRIP, MANUFACTURING METHOD AND DEVICE

Technical Field of the Invention

The present invention relates to weather strips and, in particular, hollow type weather strips, methods for manufacturing hollow type weather strips and loading devices used for manufacturing hollow type weather strips.

Background of the Invention

Conventionally, a weather strip has been mounted to a motor vehicle at door portions, window portions and trunk portions or roof side portions for blocking rain water or washing water from entering into the inside of a vehicle. In general, a weather strip is of a hollow type, that is, it has a hollow section formed of an elastomer for sealing a gap between parts of a motor vehicle, for example, between a door and a vehicle body. Fig. 1 is a perspective view showing a typical weather strip of hollow type. Such a weather strip 1 must be mounted in conformity with the shape, such as a curve, of a part of a motor vehicle. As shown in Fig. 2, when a weather strip 1 is bent in excess of a certain amount to form the bent portion 4, there may arise deformations such as wrinkles and collapses (X) in the hollow section, which not only impairs the appearance, but also degrades the water-tightness or air-tightness, which is an important performance requirement of the weather strip. Therefore, various solutions are proposed to overcome the problem.

For example, Japanese Unexamined Patent Publication (Kokai) No. 63-112242 discloses a method for preventing the deformation of a hollow section by inserting a bar-shaped reinforcing sponge rubber into a weather strip hollow section using air pressure by means of an air gun. Japanese Unexamined Patent Publication (Kokai) Nos. 03-169762 and 04-113950 disclose a method for inserting a sponge rubber member using an air gun as described above, wherein the contact area between the inside of the hollow section and the sponge rubber member is decreased by adopting suitable shape for the sponge rubber member so as to reduce the frictional force between them in order to permit smoother insertion of the sponge rubber member.

With the methods as disclosed in these Patent Publications, there are problems such as: (1) low precision of the insertion position, since the insertion position of the

sponge rubber member is adjusted by controlling air pressure, (2) insufficient prevention of deformation of a weather strip at the time of bending, when the diameter of the sponge rubber member is decreased for ease of insertion, and (3) difficulty in insertion, when the diameter of the sponge rubber member is increased, although the hollow section then tends not to be deformed.

As a method to resolve these problems, Japanese Unexamined Patent Publication (Kokai) No. 62-256626 discloses a method for manufacturing a weather strip having a hollow section, wherein an expandable corner piece is inserted to a predetermined position of a weather strip, and the unvulcanized and unfoamed weather strip base member and an expandable corner piece are coextruded from an extrusion molding die and then vulcanized and foamed. In this method, however, it is difficult to control appearance and shape of the weather strip since, because of the simultaneous vulcanization and foaming of the outer hollow section and an expandable corner piece, the foaming of the corner piece may take place before curing of the outer hollow section by vulcanization, leading to inflation of the hollow section, which may also lead to a problem in sealing function. In addition, the extrusion machine may become complicated since coextrusion is required.

On the other hand, Japanese Unexamined Patent Publication (Kokai) No. 01-263008 discloses a method for manufacturing a weather strip, wherein a liquid expandable material is poured into a hollow section by piercing a syringe stylus from its outer surface, and is foamed and cured to form a reinforcing filling member. In this method, the reinforcing material is restricted to a liquid material, and therefore has fluidity before foaming/curing so that dislocation of reinforcement may occur during the process. Therefore, from the time of pouring of the liquid until it has been cured, the hollow section needs to be covered and must not be hung vertically, in order to prevent sagging of the poured liquid.

Summary of the Invention

The present invention can provide a method for manufacturing a weather strip that is capable of disposing reinforcing expandable material easily at a predetermined position and foaming reliably at the predetermined position without giving dislocation of reinforcement.

The present invention can provide an improved foam containing weather strip.

In accordance with one aspect of the present invention, a method is provided for manufacturing a hollow type weather strip having a hollow section. The method comprises providing an expandable reinforcing filling member formed of a solid thermo-foaming material. The filling member has a pressure-sensitive adhesive on an exterior or adhesive surface thereof. The method also includes inserting the filling member from an end portion of the weather strip into an intermediate portion (i.e., not necessarily an end portion) of the weather strip; and foaming (e.g., by heating or other conventional methods) the inserted expandable reinforcing filling member so as to reinforce the intermediate portion of the weather strip. The intermediate portion of the weather strip can be a portion of the weather strip that is bent or is to be bent. Such an expandable reinforcing filling member can be accurately inserted into the weather strip to at least an intermediate position in the hollow section such as, for example, a position corresponding to a bent portion, or a portion to be bent, of the weather strip.

In accordance with another aspect of the present invention, a loading device is provided for loading or inserting the filling member into the hollow weather strip. The loading device comprises a reinforcing member support part and a locking part for inserting the reinforcing member into at least a predetermined position.

In accordance with yet another aspect of the present invention, a loading device is provided that can be used, for example in accordance with the above manufacturing method, to easily insert the aforementioned expandable reinforcing filling member into the hollow section of the weather strip. Such a loading device can comprise a support part for supporting the expandable reinforcing filling member by partially enclosing same, and a locking part for blocking the sliding motion of the expandable reinforcing filling member on the support part at the time of insertion of the expandable reinforcing filling member.

In accordance with an additional aspect of the present invention, a weather strip is provided in an intermediate form that comprises a hollow portion containing an expandable reinforcing filling member formed of a solid thermo-foaming material having a pressure-sensitive adhesive on an exterior surface thereof, wherein the hollow portion is only partially filled by the expandable reinforcing filling member.

In accordance with a further aspect of the present invention, a weather strip is provided in a more finished form that comprises a hollow portion completely, or at least mostly, filled with a partially or fully expanded reinforcing filling member formed of a

solid thermo-foaming material having a pressure-sensitive adhesive on an exterior or adhesive surface thereof, wherein the pressure sensitive adhesive adheres the adhesive surface to all or a substantial part of an interior or adherend surface of the hollow portion.

Brief Description of Drawings

Fig. 1 is a perspective view showing a hollow type weather strip;

Fig. 2 is a perspective view showing deformation at the bent portion of the weather strip shown in Fig. 1;

Figs. 3(a) and 3(b) are perspective views showing a hollow section of a weather strip that is cut at the position of an inserted expandable and expanded reinforcing filling member; and

Fig. 4 is a perspective view showing a loading device useful in the method of the present invention.

Detailed Description of the Invention

Fig. 1 is a perspective view showing a typical hollow type weather strip. The weather strip 1 comprises a hollow section 2 having sealing function and an attaching portion 3 for attaching the weather strip to the part of a motor vehicle to be sealed. The weather strip 1 is usually formed of ethylene-propylene elastomer such as ethylene-propyrene-diene terpolymerized elastomer (EPDM rubber), or chloroprene elastomer. More particularly, it is obtained by molding a unvulcanized elastomer material together with a vulcanizing agent, a vulcanization accelerator, and a foaming agent using an extrusion molding machine.

Figs. 3(a) and 3(b) are perspective views showing a hollow section of a weather strip cut at the position of the inserted expandable reinforcing filling member. Fig. 3(a) is a view showing the hollow section before foaming and cross-linking of the filling member, and Fig. 3(b) is a view showing the hollow section after foaming and cross-linking of the filling member. The expandable reinforcing filling member 5 formed of a solid thermo-foaming material with a pressure-sensitive adhesive surface is inserted from an end portion of the weather strip to the position of the hollow section corresponding to a bent portion of the weather strip (i.e., a portion of the weather strip that is or will be bent when the weather strip is in use), and the expandable reinforcing filling member can be

thereafter foamed (e.g., by heating) to manufacture the weather strip having the bent portion reinforced. Insertion of the expandable reinforcing filling member is carried out, for example, as shown in Fig. 4, by using a loading device 6 comprising a support part 7 for supporting by partially enclosing the expandable reinforcing filling member and a locking part 8 for blocking the sliding motion of the expandable reinforcing filling member on the support part at the time of insertion of the expandable reinforcing filling member. Such a loading device 6 may be graduated so that the distance for insertion from the end portion of the weather strip can be measured easily. Or, it may be provided with a stopper 9 that is slidable in the longitudinal direction of the loading device. Such a stopper 9 may be set at a predetermined position in accordance with the distance for insertion. Then, the loading device 6 may be inserted into the hollow section to the position of the stopper 9 so that the reinforcing filling member 5 can be easily inserted to the desired position. Material of the loading device is not specifically limited as long as it is suitable for insertion of the reinforcing filling member. Preferably, the surface of the loading device 6 may be processed into a less adherent surface, such as by coating with tetrafluoroethylene resin (PTFE). With such a surface, good slippage is obtained between the loading device and the elastomer such as EPDM elastomer constituting the hollow section 2 of the weather strip 1. In addition, after insertion, the loading device 6 can be easily separated from the expandable reinforcing filling member 5 having a pressure-sensitive adhesive surface.

As described above, in accordance with the method of the present invention, an expandable reinforcing filling member having a pressure-sensitive adhesive surface is inserted into the hollow section of the weather strip. The expandable reinforcing filling member may have a pressure-sensitive adhesive property in the entire material, or may have a pressure-sensitive adhesive property imparted by disposing a pressure-sensitive adhesive over the whole circumferential surface, or may have a pressure-sensitive adhesive property partially imparted by disposing a pressure-sensitive adhesive over a part of the circumferential surface. Because of the pressure-sensitive adhesive surface of the expandable reinforcing filling member, after insertion and before foaming process, the reinforcing member can be fixed to the hollow section of the weather strip. The expandable reinforcing filling member is foamed by heating, and thereby comes into close contact with the hollow section with no gap so as to reinforce the hollow section.

Preferably, the expandable reinforcing filling member is cross-linkable so as to achieve a cross-linked structure to obtain sufficient mechanical strength as a reinforcing agent. Since, after foaming, good flexibility property of the weather strip is required when the weather strip is to be mounted, the expandable reinforcing filling member should have the same elastomeric property as the weather strip itself.

Cross-linking type expandable reinforcing filling member that can be advantageously used in the present invention will be described in detail below. Such an expandable reinforcing filling member consists of a thermo-crosslinking expandable composition including a thermo-crosslinking pressure-sensitive adhesive matrix, a thermo-crosslinking agent and a thermo-foaming agent.

The thermo-crosslinking pressure-sensitive adhesive matrix can give good tack to the cross-linking type expandable reinforcing filling member. The thermo-crosslinking pressure-sensitive adhesive matrix is basically a polymer formed from a polymerizable precursor. The polymerizable precursor contains prepolymer formed from polymerizable monomer under the presence of a predetermined amount of initiator. The polymerizable monomer mainly contains acrylic monomer because of the ease of blending, good weather resistance, and because it has little influence on environment. More specifically, above-mentioned acrylic monomer contains at least one monomer selected from the group consisting of 1-functional unsaturated (meth)acrylate ester of non-tertiary alkyl alcohol having relatively low polarity and mixture thereof. The alkyl group of above-mentioned alcohol has about 4 to about 12 carbons, and in order to form an elastomer, above-mentioned monomer preferably has, as a homopolymer, a glass transition temperature (Tg) of about -60°C to 200°C. Examples of such a polymerizable acrylic monomer include n-butyl acrylate, ethyl acrylate, methyl acrylate, hexyl acrylate, 2-ethyl hexyl acrylate, isooctyl acrylate, isononyl acrylate, dodecyl acrylate, lauryl acrylate, isobornyl (meth)acrylate, methyl methacrylate, 2-phenoxyethyl acrylate, benzyl acrylate, phenyl acrylate, and the acrylate or methacrylate monomer(s) may be used alone or as a combination of the two or more monomers.

Also, as required, polar monomer such as N-vinyl pyrrolidone, N-vinyl caprolactam, lower alkyl substituted acrylamide such as N,N-dimethylacrylamide, imidoacrylate, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, acrylic acid, itaconic acid, fumaric acid, maleic acid, may be included in the polymerizable monomer to

constitute the prepolymer. In this case, the polar monomer may be included in the maximum amount of 45 parts by weight relative to 55 to 100 parts by weight of acrylic monomer of low polarity. By selecting acrylic monomer in this range, a pressure-sensitive adhesive property can be given to the elastomer.

Above described polymerizable precursor can be produced by any of known polymerization methods, such as solution polymerization, emulsion polymerization, suspension polymerization, bulk polymerization, etc. Among them, bulk polymerization can be advantageously used, because solvent or the like needs not be dumped, the process is simple, productivity is high, and because it gives no harm to environment. This polymerization method is the radiation polymerization in which mixture of aforementioned monomers is exposed to radiation such as ultraviolet ray, EB, or the like for polymerization.

In the polymerization by ultraviolet ray, for example, the initiator for the polymerization is not specifically restricted. As a radical polymerization initiator, Irgacure (Trade name) from Ciba Specialty Chemicals Co., Darocure (Trade name) from Merck Japan Co., and Velsicure (Trade name) from Velsicol Co., are commercially available. Photoinitiators are used generally in the amount of about 0.01 to 5 parts by weight for 100 parts by weight of acrylate monomer.

Preferably, above-mentioned polymerizable precursor further contains cross-linkable acrylic monomer. The cross-linkable acrylic monomer gives properties such as deformation resistance or the like to the cross-linkable pressure-sensitive adhesive matrix before thermo-foaming and thermo-crosslinking. Such a cross-linkable acrylic monomer is not specifically restricted as long as it is a polymerizable monomer having a cross-linking point. Acrylic monomer having glycidyl group, hydroxyl group, carboxyl group, can be advantageously used.

Preferably, this cross-linkable acrylic monomer is contained in the amount of 0.1 to 20 parts by weight for 100 parts by weight of above-mentioned prepolymer. If the cross-linkable acrylic monomer is contained in the amount less than 0.1 part by weight, cross-linking is insufficient so that deformation resistance of the reinforcing filling member is not adequate. On the other hand, if the cross-linkable acrylic monomer is contained in the amount more than 20 parts by weight, the glass transition temperature becomes higher so that a pressure-sensitive adhesive property may be markedly degraded.

In addition to a predetermined amount of initiator, a chain transfer agent may be added to the polymerizable precursor, as required. By conducting polymerization of the prepolymer and the cross-linkable acrylic monomer with a chain transfer agent added in conjunction with the initiator, a cross-linkable pressure-sensitive adhesive matrix with proper degree of polymerization can be formed. The initiator is not specifically restricted, and benzoin alkyl ether, benzophenone, benzyl methyl ketal, hydroxycyclohexyl phenylketone, 1,1-dichloro acetophenone, 2-chlorothioxanthone, or the like, can be used. The chain transfer agent may be used for limiting the progress of above-described polymerization, and by reducing the molecular weight of the polymer, it can adjust the foam density of the resulting product, cross-linkable pressure-sensitive adhesive matrix, and surface pressure-sensitive adhesive property and appearance of the foamed composition.

Specifically, examples of the chain transfer agent include halogenated hydrocarbon such as carbon tetrabromide, or sulfur compound such as isooctylthioglycolate, octylthioglycolate, lauryl mercaptan, butyl mercaptan, or the like.

As described above, the cross-linkable expandable composition further includes a thermo-foaming agent and a thermo-crosslinking agent. A thermo-foaming agent decomposes with heat to generate a gas such as carbon dioxide, nitrogen, or ammonia. If such a thermo-foaming agent is dispersed in the cross-linkable pressure-sensitive adhesive matrix, after thermo-crosslinking and thermo-foaming of the cross-linkable expandable composition, foam structure is formed. Examples of thermo-foaming agent include (i) inorganic foaming agent such as ammonium bicarbonate, ammonium nitrite, or the like, (ii) nitroso compounds such as N,N'-dinitroso pentamethylene tetramine (DPT) or the like, (iii) azo compounds such as azodicarbonamide (AZC), azobisisobutylnitrile (ABIN), or the like, (iv) sulfonyl hydrazide compounds such as benzene sulfonyl hydrazide (BSH), toluene sulfonyl hydrazide (TSH), 4,4-oxybis(benzene sulfonyl hydrazide) (OBSH) or the like. Known foaming promoter may be used in conjunction with the foaming agent in order to increase foaming speed and lower foaming temperature.

The thermo-crosslinking agent is sensitive to heat, and is capable of forming cross linkage between polymers of cross-linkable pressure-sensitive adhesive matrix. Cross-linkage will impart a sufficient strain resistance to the reinforcing filling member after

thermal expansion. As thermo-crosslinking agent, epoxy compounds, amide compounds, amine compounds, acids, and acid anhydrides, for example, may be mentioned.

By the action of the thermo-foaming agent and thermo-crosslinking agent upon application of heat, foam structure and cross-linking structure are given to the aforementioned cross-linkable foam composition. Preferably, in order for the cross-linking structure and foam structure to be formed approximately at the same time, the thermo-foaming agent and the thermo-crosslinking agent are suitably selected. Foaming and cross-linking are usually carried out by heating at 80°C to 150°C for 10 to 30 minutes. Further, by suitably adjusting the blended amount of the thermo-foaming agent and thermo-crosslinking agent, and molecular weight of the cross-linkable pressure-sensitive adhesive matrix, it is also possible to control the density and the cellular size of the reinforcing filling member. In practice, by such adjustment of the blended amount and the molecular weight, the density of the reinforcing filling member after foaming and cross-linking can be controlled typically in the range of 0.02 to 8.0 g/cm^3, preferably in the range of 0.05 to 5.0 g/cm^3, and more preferably in the range of 0.1 to 3.0 g/cm^3.

EXAMPLES

Example 1

First, polymerizable monomer and initiator were placed into a jar to prepare a mixture. The polymerizable monomer consisting of 80 parts by weight of 2-ethylhexyl acrylate and 20 parts by weight of N,N-dimethylacrylamide was used. As the initiator, a photo-initiator available from Ciba Specialty Chemicals Co. as a trade name of Irgacure (Trade Mark) 651 was used in an amount of 0.04 parts by weight. Then, the mixture was purged from the jar using nitrogen gas, and the mixture was irradiated with ultraviolet ray using a fluorescent black electric bulb (Sylvania F20T12B) having 90 % of radiation contained in the range 300 to 400 nm and maximum intensity at 351 nm. By thus activating the photo-initiator, polymerization of the polymerizable monomer was initiated to prepare a prepolymer. In the present example, this polymerization was continued until the viscosity of the prepolymer reached about 3000 mPa·s.

Next, while the mixture containing above-mentioned prepolymer was stirred, a cross-linkable acrylic monomer consisting of 3 parts by weight of glycidyl methacrylate, the photo-initiator consisting of 0.1 part by weight of Irgacure 651, and 0.03 parts by

weight of carbon tetrabromide, were added. Then, after exhausting the gas from the jar, by irradiating the mixture again with above-mentioned ultraviolet ray, unreacting monomer in the mixture was further polymerized to produce a cross-linkable pressure-sensitive adhesive matrix.

Next, above-mentioned cross-linkable pressure-sensitive adhesive matrix was placed into a twin-screw extruder and kneaded at temperature of 80°C. Then, from intermediate portion of the cylinder of aforementioned twin-screw extruder, 30 parts by weight of calcium carbonate, 4.0 parts by weight of dicyandiamide, 1.0 part by weight of imidazole curing promoter (manufactured by Sikoku Kasei Kogyo Co., 2MZA-PW), and 5.0 parts by weight of 4,4-oxybis (benzene sulfonylhydrazide) were added to prepare a cross-linkable expandable composition. Then, the cross-linkable expandable composition was extrusion-molded through a die, and cut to obtain bar-shaped samples of 5 mm in diameter and 50 mm in length.

The bar-shaped sample as described above was mounted inside a hollow section (inner diameter of 15 mm) of a weather strip formed from EPDM elastomer as shown in Fig. 1, and placed in an oven at a temperature of 150°C for 30 minutes to allow the sample to be foamed and cross-linked.

Comparative Example 1

In the hollow section of the weather strip identical to that used in Example 1, a foamed pad made of EPDM elastomer of 10 mm in diameter and 50 mm in length was inserted by air pressure.

Comparative Example 2

Using the hollow section of the weather strip identical to that used in Example 1, one-liquid type expandable urethane (Aerofloss: manufactured by Nippon Polyurethane Industry Co.) was introduced into the hollow section by means of a syringe stylus, and placed in an oven at a temperature of 150°C for 30 minutes to allow the sample to be foamed and cross-linked.

Result of evaluation of above-mentioned Example and Comparative examples is shown in Table 1 below.

Table 1: Result of evaluation

	Example 1	Comparative Example 1	Comparative Example 2
Workability	A	C	B
sealing performance of reinforcing member	A	B	A

In the Table, symbols have the following meaning: with regard to workability, A: both insertion of the reinforcing filling member and workability are good. B: insertion of the reinforcing filling member is good, but workability is insufficient, for example, flow of liquid after injection needs to be prevented. C: workability is poor, and skill is required for insertion of the reinforcing filling member to the desired position. With regard to sealing performance of the reinforcing member, A: good. B: there is gap between the hollow section of the weather strip and the reinforcing member.

In accordance with the manufacturing method of the present invention, an expandable reinforcing filling member can be easily inserted to the desired position of the hollow section of the weather strip using a simple loading device.

Since foaming takes place inside the hollow section, the reinforcing member can seal the weather strip with no gap, and failure of sealing of weather strip due to collapse of the bent portion of the hollow section can be avoided.

Further, since a solid expandable reinforcing filling member having a pressure-sensitive adhesive surface is used, the reinforcing member can be fixed reliably at a predetermined position even before foaming and cross-linking, and care is not necessary for prevention of sealing failure as in the case of liquid expandable sealant where sealing failure may occur due to liquid flow before foaming and cross-linking.

We claim:

1. A method for manufacturing a hollow type weather strip having a hollow section, said method comprising:

providing an expandable reinforcing filling member formed of a solid thermo-foaming material having a pressure-sensitive adhesive on an adhesive surface thereof;

inserting the filling member from an end portion of the weather strip into an intermediate portion of the weather strip; and

foaming the inserted expandable reinforcing filling member so as to reinforce the intermediate portion of the weather strip

2. The method according to claim 1, wherein during said inserting, the intermediate portion of the weather strip is a portion of the weather strip that is to be bent.

3. The method according to claim 1 or 2, wherein said foaming is caused by heating the inserted expandable reinforcing filling member.

4. The method according to claim 1 or 2, wherein said inserting comprises using a loading device to insert the expandable reinforcing filling member into the hollow weather strip, the loading device comprising a reinforcing member support part and a locking part for inserting the reinforcing member into at least a predetermined position in the hollow weather strip.

5. The method according to claim 4, wherein the support part supports the expandable reinforcing filling member by partially enclosing same, and the locking part blocks a sliding movement of the expandable reinforcing filling member on the support part during the inserting of the expandable reinforcing filling member.

6. The method according to claim 4, wherein the loading device further comprises a slidable stopper set at a predetermined position in accordance with the distance for insertion.

7. A weather strip in an intermediate form comprising a hollow portion containing an expandable reinforcing filling member formed of a solid thermo-foaming material, the filling member having a pressure-sensitive adhesive on an exterior surface thereof, wherein the hollow portion is only partially filled by the expandable reinforcing filling member.

8. A weather strip comprising a hollow portion filled with an expanded reinforcing filling member formed of a solid thermo-foaming material, the filling member having a pressure-sensitive adhesive on an adhesive surface thereof, wherein the pressure sensitive adhesive adheres the adhesive surface to an interior surface of the hollow portion.

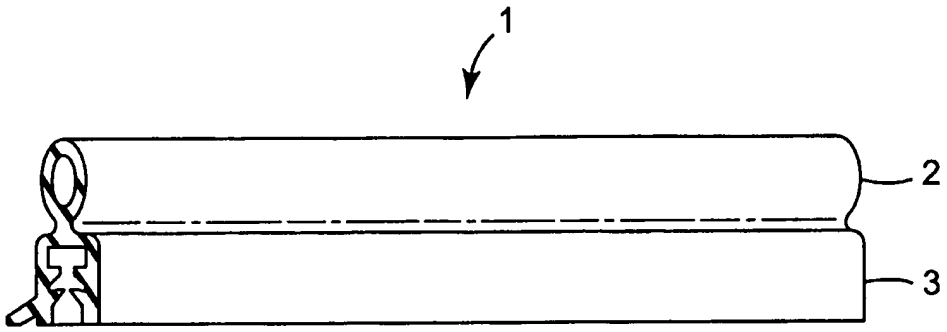


FIG. 1

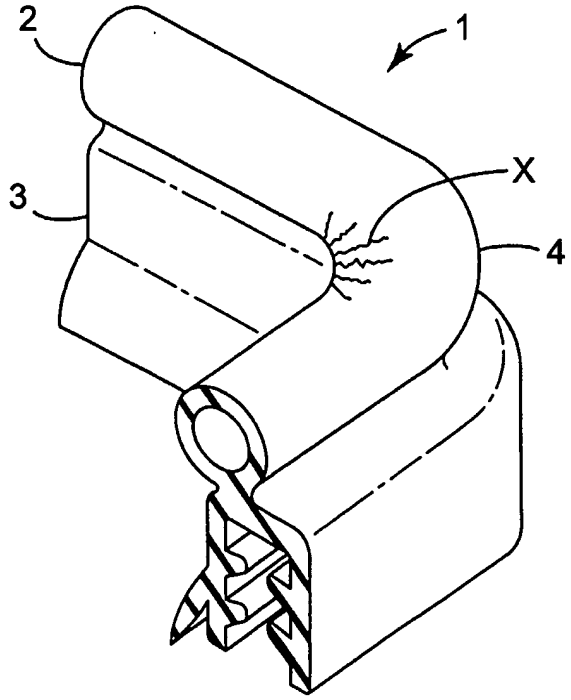


FIG. 2

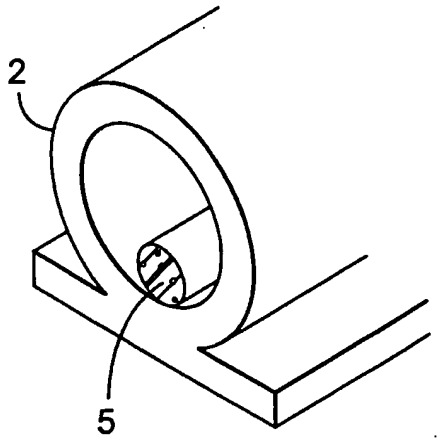


FIG. 3a

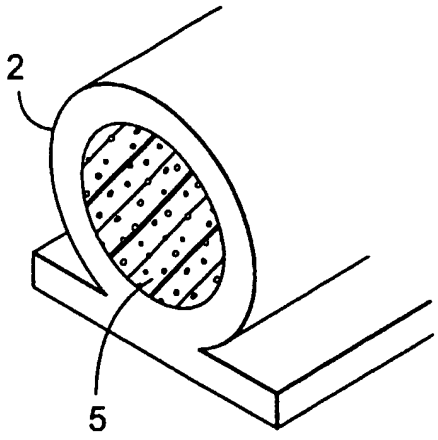


FIG. 3b

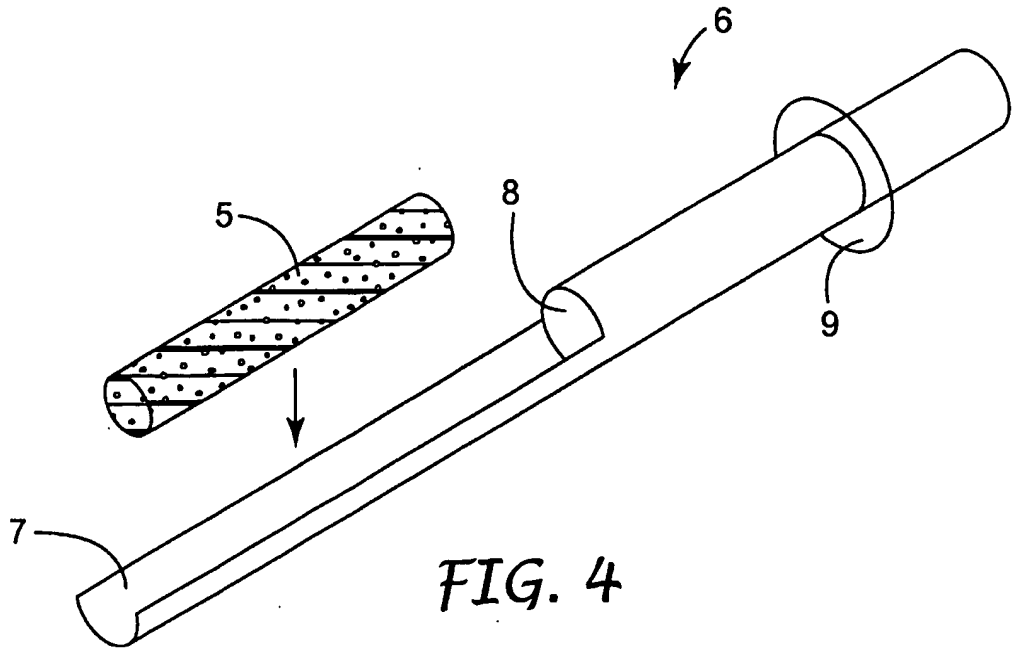


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/16021

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B29C44/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B29C B60J F16J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 559 251 A (PIRELLI) 16 January 1980 (1980-01-16)	7
A	page 1, line 34 - line 50	1,2
A	PATENT ABSTRACTS OF JAPAN vol. 012, no. 134 (M-689), 23 April 1988 (1988-04-23) & JP 62 256626 A (TOYODA GOSEI CO LTD), 9 November 1987 (1987-11-09) cited in the application abstract	1-3,7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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5 September 2003	11/09/2003

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 03/16021

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
GB 1559251	A	16-01-1980	IT	1063560 B	11-02-1985
JP 62256626	A	09-11-1987	JP	1773818 C	14-07-1993
			JP	4060420 B	28-09-1992